Harvard Study

Profound Effects of Interactive Metronome and Brain Balance Exercises on a Subset of Children with Attention Deficit Hyperactivity Disorder

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RESULTS:
Preliminary results from this ongoing study showed that 5 of 14 children (36%) diagnosed with ADHD demonstrated 40% or greater improvement on standardized neuropsychological measures of hyperactivity and spatial working memory (the executive function most notably impaired in ADHD) following completion of a combined Interactive Metronome (IM) and Brain Balance (BB) training protocol. According to Dr Teicher, “this is a degree of improvement that we have not previously observed in children with ADHD unless they were receiving medications, and then only if they were receiving the correct medication at optimal dose.”
Neuroimaging of brain regions strongly implicated in the neurobiology of ADHD helped to parse out the influence of each training program and the effect of combining them. Specifically, scans showed that BB training was associated with increased connectivity between prefrontal cortex and the frontal pole, temporal pole, cerebellum, precentral gyrus and supramarginal gyrus with extensive effects on connectivity of the amygdala and hippocampus, which are involved in implicit and explicit memory as well as stress response.

Increased connectivity of the amygdala with supramarginal gyrus, cingulate gyrus, anterior cingulate, angular gyrus, frontal pole and precuneus were associated with combined IM and BB training. Greater connectivity between the amygdala and cingulate allows for better emotional self-regulation and impulse-control.

IM training was associated with increased connectivity between the hippocampus and the angular gyrus, precuneus, middle temporal gyrus, lateral occipital cortex, supramarginal gyrus, cingulate gyrus and

frontal pole, areas responsible for language processing, memory retrieval, handwriting, mathematical calculations, and L/R discrimination. A closer examination of the impact on the cerebellum revealed that IM training was associated with increased resting state functional connectivity between: cerebellum I and middle frontal gyrus; cerebellum II and inferior temporal gyrus/fusiform gyrus; cerebellum IV-V and parahippocampal gyrus and inferior temporal gyrus/fusiform gyrus; cerebellum VII and lateral occipital cortex; cerebellum VIII and superior frontal gyrus and cerebellum IX and lingual gyrus and postcentral gyrus. IM training was also associated with decreased resting state functional connectivity between cerebellum III and
anterior cingulate gyrus and cerebellum VI and lateral occipital gyrus.
“These appear to be potent changes. Our findings of symptomatic improvement and enhanced connectivity of the supramarginal gyri with the amygdala, hippocampus, and prefrontal cortex is consistent with a recent report showing that reduced connectivity of the left and right supramarginal gyri was associated with increased symptom severity in ADHD24. Given the role these regions appear to play in timing makes these observations particularly compelling.” Research is ongoing and will continue to investigate and further define the host of neurobiological changes associated with IM and BB training as well as their relationship to clinical outcome for individuals with ADHD.

DETAILS:

- n=14 (8-14 years of age) confirmed to have ADHD through structured diagnostic interview (K-SADS-PL)
- intervention: 15 weeks of combined Interactive Metronome and Brain Balance training (up to 75 sessions) were completed remotely via online access
    - standardized exercises with no individualization
    - not directly supervised by an experienced administrator (carried out by families at home)
- clinical outcome measures:
    - ADHD Quotient System. “This test is highly responsive to the effects of medication, correlates with blood levels of methylphenidate but is not responsive to placebo. Indeed, we reported in N=30 children receiving placebo that only 7% showed a greater than 25% improvement and none had a 40% or greater improvement in Quotient scaled scores.”
    - Cambridge Neuropsychological Test Automated Battery (CANTAB) to evaluate spatial working memory
    - Neuroimaging with diffusion MRI optimized to evaluate the brain’s structural connections (part of the Human Connectome Project)